Code: 9D15203

M.Tech I Semester Supplementary Examinations February/March 2018

MECHANICAL VIBRATIONS

(Production Engineering & Engineering Design)

(For students admitted in 2012, 2013, 2014, 2015 & 2016 only)

Time: 3 hours Max. Marks: 60

Answer any FIVE questions

All questions carry equal marks

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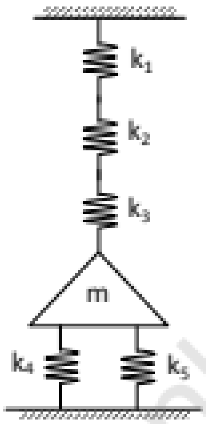
1 (a) Derive the differential equation of motion, of a single degree freedom system under the condition of Base Excitation.

(b) What do you mean by equivalent stiffness of spring? Classify the methods used to obtain equivalent spring stiffness. Using the same methods determine the magnitude of mass given in below figure.



k_1 = 200 N/m

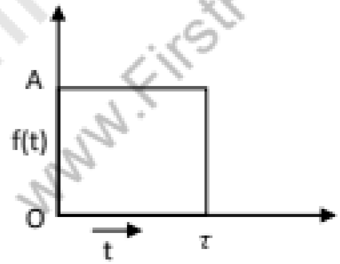
k_2 = 1500 N/m

k_3 = 3000 N/m

k4=k5= 500 N/m

2 (a) Obtain the response of a Spring-Mass-Damper system subjected to impulsive force and show the variation of response to different amount of damping with a neat sketch.

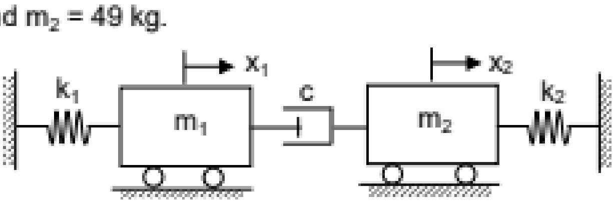
(b) What is Laplace transformation? Determine the Laplace transformation of a pulse of height A and duration τ shown in below figure. Deduce the Laplace transformation of unit impulse.



3 (a) Derive the necessary condition of a seismic instrument which behaves as a Vibrometer.

(b) Briefly explain the instruments used to measure the displacement, velocity and acceleration. With a neat sketch of frequency response curves show the range of instruments.

4 (a) Write down the differential equation of motion for the system shown in below figure. The quantities X_1 and X_2 are absolute displacements. Find the two natural frequencies when k_1 = 98000 N/m, k_2 = 19600 N/m, m_1 = 196 kg and m_2 = 49 kg.



(b) What do you mean by vibration absorber? Explain briefly the undamped dynamic vibration absorber.

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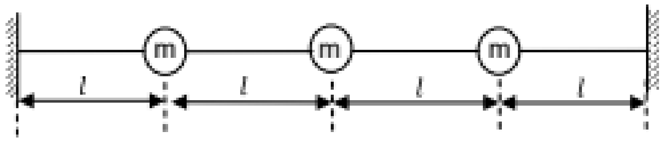
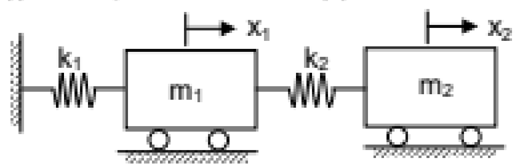
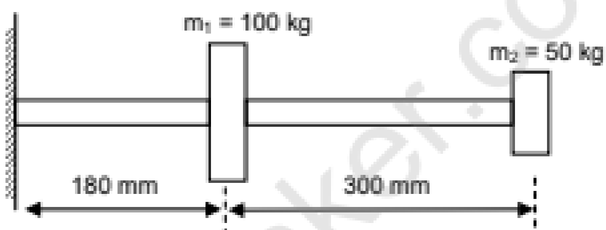
5 (a) Explain Maxwell reciprocal theorem and determine the influence coefficients of the system shown in below figure.



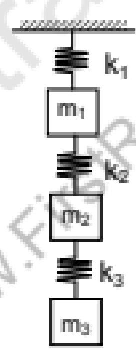
(b) For the un-damped two degree freedom system shown in below figure with generalized coordinates x_1 and x_2 determine: (i). Principal coordinates. (ii) Vibrations of the system for initial conditions.



6 (a) Determine the natural frequency of vibration for the system shown in below figure by using Rayleigh's method. Assume E = 1.96 x 10^{11} N/m^2 and I = 4 x 10^7 m^4.



(b) Find the fundamental mode of vibration and its natural frequency for the system shown in below figure using Stodola method. Take $k_1 = k_2 = k_3 = 1$ N/m and $m_1 = m_2 = m_3 = 1$ kg.



7 (a) Determine the differential equation of motion for the lateral vibration of a beam.

(b) Investigate the vibration of a bar fixed at one end and pulled at the other end by force P. The force is suddenly released.

8 (a) Define critical speed of shafts. Obtain the expression for the critical speed of shaft having a single disc at the center without damping.

(b) A disc of mass 4 kg is mounted midway between bearings which may he assumed to be simple supports. The bearing span is 48 cm. The steel shaft which is horizontal is 9 mm diameter, the CG of the disc is displaced 3 mm from the geometric center. The equivalent viscous damping at the center of the disc shaft may be taken as 49 N-s/m. If the shaft rotates at 760 rpm, determine the maximum stress in the shaft and compare it with dead load stress in the shaft, also find the power required to drive the shaft at this speed.

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